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ABSTRACT

An overview of the current status of the videodisc industry and observations on future directions for videodisc technology are presented in this paper. Information was drawn from interviews with presenters at the 1984 Nebraska Videodisc Symposium and the February 1985 Society for Applied Technology Conference, discussions with hardware manufacturers, and in-depth interviews with seven leading videodisc developers. Topics covered include: (1) applications of videodisc technology; (2) producers of videodiscs; (3) size of the videodisc industry; (4) cost and instructional effectiveness; (5) hardware characteristics, including a videodisc player comparison chart; (6) authoring systems; (7) the team approach in videodisc design and production; (8) the cost of production; (9) review of the 1984 Nebraska Videodisc Symposium, "The Industry Comes of Age;" and (10) public television station involvement in videodisc production. Descriptions of the videodisc developers interviewed, including their major achievements and concerns, are appended. (MES)

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INTERACTIVE VIDEODISC POTENTIAL AND IMPLICATIONS FOR PUBLIC TELEVISION

A Special Research Project Report

Prepared by
The Nebraska Videodisc Design/Production Group,
Station KUON-TV
The University of Nebraska-Lincoln

Major funding was provided by the Corporation for Public Broadcasting
Office of Policy Development and Planning

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November 1985

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Introduction

The videodisc industry is about eight years old, dating back to 1977 when the first prototype players were placed with the early developers. In that time, it has had both successes and failures. The videodisc has generally failed to become the great consumer product it was predicted to be and indeed one major consumer format from RCA has been withdrawn. Nevertheless, videodisc technology continues to roll along as a tool for dedicated training applications and continues to be of significant interest in public education.

The purpose of this paper is to take an overall look at the current status of the videodisc industry and to make some observations on future directions for videodisc technology. Information was drawn from observations and interviews with presenters at the 1984 Nebraska Videodisc Symposium, the February 1985 Society For Applied Technology (SALT) Conference, discussions with hardware manufacturers and in-depth interviews with seven leading videodisc developers. The latter were chosen for their representative positions in the videodisc industry. The seven developers are: Digital Equipment Corporation (DEC) and Perceptronics, both major systems developers; IXION, a company representative of the many private companies founded by early researchers; Videodiscovery, Inc., an aggressive entrepreneurial enterprise; the Army Communicative Technology Office; The University of Iowa, a leading developer of postsecondary videodisc based instruction; and the EPCOT Center in Orlando, the first big installation of videodisc systems for public contact use.

There was a great deal of common opinion among all of those consulted for this paper. This paper is a summary of their collective opinions and experiences related to issues of videodisc design, production and the future of videodisc technology. Individual attributions are noted only when there was disagreement or some significant point was made by one of the agencies or individuals interviewed.

What Is Being Produced

Videodisc technology is finding applications in a wide range of content areas but most of the applications are very specialized. It is not being used very much as a general purpose audio/video delivery medium. The videodisc is being used primarily as a random access audio-visual device under some sort of programmed control. As such it is generally being used to meet specific and narrow education or training needs. With the exception of the US Military, there has been very little use of videodisc based systems as a primary delivery system to deliver a broad range of instruction. The agencies surveyed for this report mentioned one or more of the following reasons for selecting videodisc for particular applications:

-- Applications that require a data bank of high fidelity, realistic motion or still images
-- The need for a very large visual storage capacity
-- The need for rapid, random access
-- A use that is inherently interactive, for example, simulation or that lends itself to an interactive design, as in role playing or gaming strategies
-- Subject matter that has a high density of information.

Current use then is not generally a matter of displacing some other medium such as videotape or film. It is rather an expansion into areas of education, training or information retrieval where videodisc adds a significant new dimension not possible or practical with another medium.

There are many reasons for this, such as cost in small quantities and lack of recordability. Among the producers surveyed for this report, however, it is a matter of the basic perspective from which they view the videodisc. The University of Iowa, Perceptronics and DEC see the videodisc as a valuable new computer peripheral which extends the capabilities of computer assisted instruction. The military is using the videodisc as a part-task/training device or to provide high level simulations. David Hon of IXION first used the videodisc as part of a very sophisticated stand-alone training system for CPR. EPCOT's use of videodisc is primarily for information retrieval and the videodiscs from Videodiscovery are large visual databases. In short, all of these producers view the videodisc as a very sophisticated and specialized tool to be used when other media will not work as well. IXION, in fact, often recommends the use of linear and interactive videotape instead of videodisc.

Who Are The Producers

Many different types of agencies are producing videodiscs. There are in-house training agencies who have adopted videodisc as an adjunct to their ongoing training efforts such as Arthur Anderson and Xerox. There are commercial video production agencies who have adopted videodisc production as a specialized sideline such as Devlin in New York and Windsor Video in California. Many of those involved in the early research and demonstration projects went on to form videodisc production agencies such as Jeffery Silverstein of Fusion Media and David Hon of IXION. A few of the better known groups such as WICAT were originally based in computer assisted instruction and simply embraced videodisc as an extension of that activity. Perceptronics, Cubic and other agencies heavily involved in military training adopted videodisc to enhance their delivery of military courseware. Academic agencies such as the Universities of Iowa, Nebraska and Utah State University had early academically based research grants but have continued to produce videodisc materials under various kinds of internal and external sponsorship.

With the exception of the US Military, the agencies that are producing their own videodiscs for in-house training are not at present producing large numbers of videodiscs. The videodiscs they have produced have tended to be demonstration projects or videodiscs to meet very specialized training needs. Except for DEC and the Army, no one consulted for this report knew of any agencies who had assembled a significant internal production group specifically to produce videodiscs. DEC, however, also provides services for external clients.

There are at least a dozen companies who have established large videodisc training networks who rely on external production agencies for virtually all of their videodisc software. These companies include Ford, GM, Toyota, American Motors, AT&T, IBM, Merle Norman, Miles Pharmaceuticals, Minolta, Nissan and Sizzler. Ford has over 4,000 players and GM over 11,000 players in their respective networks. The others have from 400 to over 1000 players in each of their networks. Ford and GM have had a substantial number of videodiscs produced for their networks and they continue to have new videodiscs made each year to reflect automobile model and engineering changes. The Ford videodiscs have been produced primarily by Maritz Communications of Detroit. Sandy Corporation in Troy, Michigan has produced most of the GM videodiscs. The other agencies have also relied primarily on a single external production house with the exception of IBM which has used at least six different houses.

The videodisc services directory guide published by 3M lists over 180 agencies who are supplying videodisc design and production services. Many of these agencies are quite small, however, and others are offering such services as a small sideline to their primary business of supplying traditional video or film based materials. The number of contract service agencies who are actually doing more than an occasional videodisc project is certainly less than 50.

How Big Is The Industry?

Estimating the size of the videodisc industry is a very difficult problem. Most of the present use and production of videodiscs is within single agencies. Few videodiscs end up as distributed products. In addition, the hardware manufacturers have been reluctant to release sales figures for players or videodisc mastering and replication. With so little public information, it is therefore very difficult to measure the size of the industry.

One of the best sources of information on the videodisc industry is THE VIDEODISC MONITOR. A regular feature of the MONITOR is a column called "Where Are They?". In this column, MONITOR Editor, Rockley Miller, keeps a running total of industrial videodisc players in use. In the September 1985 issue of the MONITOR, Miller has accounted for 83,250 industrial players in use. These figures, while not an exact count of the player population (the MONITOR lists only those players that have been reported by direct contact) do give some indication of the magnitude of the industry. There are certainly a significant number of industrial players in use but it is not anything approaching the magnitude of videocassette players in use.

Another rough measure of the size of the industry is to look at the videodisc mastering and replication capacity in the United States. There are at present two major mastering and replication agencies, Pioneer and 3M. Pioneer has two production lines, each with a videodisc mastering machine; 3M currently has one. In addition, there are two smaller mastering and replication facilities, Technidisc and LaserVideo, capable of videodisc mastering and replication. 3M is currently mastering

250-300 custom videodiscs per month. Figures are not available from the other facilities but it would seem clear that several hundred unique videodisc masters are being made each month. This of course means that several hundred videodisc projects are reaching the mastering and replication stage each month.

The Nebraska Videodisc Group recently commissioned Arthur Anderson and Company to conduct a current videodisc market review. In that review during the summer of 1985, Anderson examined a number of available reports and projections, cross checking them for consistency. The Anderson review projects the production of 1162 unique, non-entertainment videodisc titles in 1986. By category, Anderson projects 830 titles in training, 290 in merchandizing, 12 titles in education and 30 titles in publishing. The same review projects a total of 4465 titles in 1988 in roughly the same ratio by category. Dollar expenditures for videodisc production are projected to be $104 million in 1986 growing to $446 million in 1988.

Effectiveness

Has the videodisc proven to be an effective instructional tool? The short answer is clearly yes. There are, however, a number of factors that have made videodisc based instruction and training successful. Applications for videodisc to date have been mostly limited to those areas for which it is best suited; those requiring rapid access of material with high visual and auditory content. Videodisc has generally been used as part of a total instructional system with a lot of built-in power for such things as answer judging and remediation. These systems also support a number of instructional strategies from which the most appropriate strategy can be selected for any given subject.

Producers interviewed for this report felt that instances where videodisc has not been effective have generally been cases where good principles of instructional design were not followed or where the subject matter was not really suited to videodisc. A number of the producers stated that they had turned projects down because the subject matter or suggested treatment was essentially linear and would not be cost effective on videodisc.

Has the videodisc been effective from a cost standpoint? Here again the short answer is "yes," but there are compounding factors. The videodisc is a cost effective medium when, like any other medium, it does what it is supposed to do and the cost of doing that is less or the same as some other way of doing the same thing. It is also cost effective when it does something that cannot reasonably be done by another medium. This factor was often mentioned in the interviews as the reason for choosing videodisc, particularly in reference to archival and simulation applications.

Several of the producers have conducted formal evaluation studies on their projects and cited additional evaluation studies that support the effectiveness of videodisc on such topics as computer maintenance, medical education, training on military hardware systems, electronics and archival storage applications. Most of the learners/users were adults. The conclusions were all substantially the same:

-- Learning outcomes were the same or somewhat better when compared to the same subject taught in another medium.
-- Less time was required to learn the material.
-- The more structured and individualized approach led to less confusion and a somewhat higher degree of self satisfaction.
-- Learners/users generally liked using videodisc based systems and to some degree preferred them to systems they were previously using.

DEC conducted a fairly extensive evaluation of one of their first videodisc based computer maintenance projects (May, 1984). In that evaluation, the videodisc system had virtually the same instructional effectiveness compared to a lecture presentation format requiring high level human trainers. DEC projected considerable savings in training costs as the videodisc based system promised to be much cheaper over time.

Another study of instruction via interactive videodisc versus lecture format was made on the HAWK Training System (Gibbons et al., 1982). In that study all of the Army trainees who used an interactive videodisc system passed a post test while only 25% of the trainees who received

only a lecture presentation were able to pass. In a study of interactive videodisc based Spanish language instruction (Gale, 1983) students scored significantly better (.01 level) than a control group who received the same instruction in a linear form. Still other studies (Hooper, 1981; De Bloois and Wooley, 1981; and Holgren, 1979) found videodisc based instruction to be at least as effective as other instructional modalities.

Several studies have found considerable savings in time with videodisc instruction. DEC (May, 1984) found a 23-46% time savings. The Florida Department of Health and Rehabilitative Services achieved a 25% average reduction in training time for welfare caseworker training (Smith, 1984). Evaluation of the HAWK Training system found that students trained with videodisc were able to perform maintenance tasks in one half the time (Gibbons et al, 1982).

Learners reported positive attitudes toward videodisc in several studies. Railroad workers who participated in a pilot project to teach safety measures responded very favorably to the training and indicated a desire to have the videodisc integrated into their regular training program (Fitzsimmons, 1984). DEC reported very favorable response by trainees (May, 1984) as did Florida (Smith, 1984) and trainees in the Army (DeBloois and Wooley, 1981).

This is all very positive in terms of videodisc but frankly not surprising. Most of the projects had undergone careful formative evaluation and revision processes and were designed by excellent designers. Several of the producers interviewed for this report also indicated that the rather extensive design process that videodisc instruction mandates should, of itself, ensure that the courseware works successfully.

Hardware

In 1984 the hardware manufacturers released a whole new generation of videodisc players. Without exception the manufacturers have all placed new machines with new features on the market. There are several significant trends in this new generation of players.

Perhaps the most significant trend is the use of solid state lasers in the new players. All manufacturers except North American Philips have eliminated the gas laser in their newest players. This has meant generally lighter, more compact players with faster random access. It is also claimed that the solid state laser will last much longer and will be much cheaper to replace than the gas laser.

With the exception of the Philips player, all of the new players are front loading. A drawer slides out of the front of the player and the videodisc is simply placed in the drawer. The front loaders do not require a space higher than the player since there is no pop-up lid and they can be rack mounted. All of the top-of-the-line players now have built in interfaces, allowing them to be controlled directly by a computer without special out-board interface devices. This is an important trend as it will make it easier to produce computer control software that will work with more than one player. The lower level players still require out-board interface adapters.

Several of the new players feature a certain degree of modularity, allowing the player to be customized for different uses. The new Sony LDP-2000 is the most modular in nature, providing a series of boards that upgrade the base player for a higher level computer interface, internal memory for Level Two use and still frame audio. The Pioneer LD-V6000 and

Philips VP935 have the capability of being upgraded to a lesser degree by a change of EPROM.

User Recordable Videodiscs

There are three systems that allow on-site recording of videodiscs. Two of them, the Panasonic and Hitachi systems, use optical laser technology that is not compatible with standard optical videodiscs. The third, the MDEC system from McDonnell Douglas Electronics, uses a technology which is something like recording on a disc-shaped piece of film. The Panasonic and Hitachi systems are so-called DRAW or Direct Read After Write videodiscs. Information is recorded directly on the videodisc that is used in playback, unlike conventional videodiscs where a physical replica of the original is used for playback. The MDEC process on the other hand provides for mass replication of the original recording. The MDEC recorder is quite expensive, in the $250,000 range, and is therefore suitable only for large scale users or centralized mastering. The Panasonic Videodisc Recorder is about $25,000 with a playback only unit at about $3000. Blank Panasonic system videodiscs which will contain 13 minutes of motion or 24,000 single frames are $260. Prices have not been announced for the Hitachi DRAW system but should be comparable to Panasonic.

Integrated Computer/Videodisc Systems

There are three integrated videodisc/computer systems available from major manufacturers as well as several after-market systems from suppliers who market components that they package along with an interface of their own manufacture. DEC, Sony and NCR all sell integrated systems with a computer, videodisc player, monitor, control peripherals and authoring software. System prices ranges from about $14,000 for DEC's IVIS system to $8500 for the Sony VIEW system. All three systems have keyboard as well as touch screen input capability, built in disk drives and authoring systems for creating control software and graphics. These integrated systems are the cadillacs of interactive videodisc systems offering a large variety of very desirable features. They are relatively easy to design and produce for with their authoring systems and are ideal for stand-alone work stations. Perhaps their biggest advantage is the ease of buying a complete system and of receiving after-sale service from a single supplier. The disadvantage is price. A system with compnents from separate suppliers can be put together for $4000 to $6000.

Input Peripherals

The choice of input devices used to control the videodisc player is based on three criteria: cost, the nature of the material and the audience. The least expensive control peripheral for a Level Three system is, quite naturally, the computer keyboard. It comes with the computer and requires no special software or peripherals to operate. If the computer keyboard is the least expensive it is also the least "user

friendly." The basic problem is the fact that it has so many more keys than are functional in most cases and thus presents a confusing maze to users, particularly users without typing skills.

Touch screens and light pens are very popular for videodisc applications because they are generally very simple to use and do not require the user to break eye contact with the screen. There can also be a kind of direct, one-to-one connection. For example, the user can be asked to identify the correct part by touching the image or touching the correct answer from a menu.

In simulation applications, 3-D input devices have been frequently employed. A 3-D device is a device that emulates the kind of controller that one would be using to control the system that is being simulated. For example, one might use a steering wheel like device to control a driver training videodisc lesson.

System Reliability

The videodisc developers surveyed for this report were asked to rate the reliability of videodisc players. Universally, they gave the players very high ratings. One developer had a bad experience with a particular brand of player but others using the same player rated it very high. Generally developers rated the level of reliability of a videodisc player as high or higher than videocassette players. When asked to identify the least reliable element in Level Three external computer controlled systems, floppy disk drives were the most frequent response followed by videodisc controller/interface cards. Videodisc players and the computers were rated about equally reliable in Level Three systems.

The Future

The producers interviewed for this report see several significant hardware advances that will have significant impact on interactive video including: still frame audio, artificial intelligence, CD-ROM and videodiscs with both digital and analog data.

Still frame audio (SFA) or the ability to have audio with still images on the videodisc has been available since early 1984 but it is just now beginning to be utilized. There were mixed feelings about the impact of SFA. Those producers who are producing videodiscs with large numbers of single frames felt that the impact would be considerable. Others were concerned with the cost of an additional peripheral for decoding SFA and felt that its impact on the delivery of instruction was not great enough to warrant the additional expense.

The advent of artificial intelligence (AI) in a learning system was of considerable interest to most of the producers. They felt that AI could provide a much higher level of individualization as the system would potentially be able to modify the courseware as the system learned how users were performing. The ramifications of that are obviously enormous and no one was willing to do more than "muse" about how such a system might work.

The CD-ROM and digital plus analog recording on the videodisc are considered very significant for the future. The ability to have mass digital storage either in a peripheral with the CD-ROM or on a digital/analog videodisc suggests such possibilities as large scale use of videotex with videodisc, very large database management software to

accompany still images on a videodisc and in the case of the digital/analog videodisc, the elimination of the separate computer floppy disk(s).

VIDEODISC PLAYER FEATURE COMPARISON SHEET JUNE 1985

	PIONEER LD-V1000	PIONEER LD-V4000	PIONEER LD-V6000	PIONEER LD-660	PIONEER LD-700	PIONEER CLD-900	PIONEER PR-8210*	SONY LDP-1000A*	SONY LDP-2000	SONY LDP-180	HITACHI VIP-9500	HITACHI VIP-9550	PHILIPS VP 935	MAGNAVOX VC-8040GY
Player Type: Consumer=C/Industrial=I	I	I	I	C	C	C	I	I	I	I	I	I	I	C
Player Level	III	I III	I II III	I	I III		I III	I II III	I II III	I III	I III	I III	III	I III
Plays: CAV Discs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CLV Discs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD Discs						✓								
Maximum Access Time (in seconds)	3	6	3	NA	NA	NA	14	5	3	6	3	3	3	NA
Fast Play Speed: Forward/Reverse (Multiple of Normal Play Speed)	1x-5x	2x, 3x	2x, 3x	70x	3x, 9x	3x	3x	3x-100x	NA	2x, 3x	3x	1x-5x	20x, 75x,	3x, 9x
Slow Play Speed: Forward/Reverse (Multiple of Normal Play Speed)	1/4x, 1/2x	1/16-1/2x	1/127-1/2x	1/60x	1/16-1/2x	1/20-1x	VARIABLE	1/120x-1x	NA	2x, 3x	1/5x, 1/10x	1/127-1x	1/120-1x	1/16-1/2x
Automatic Replay		✓			✓	✓				✓		✓		✓
RS-232 Computer Interface	✓	✓	✓					✓	✓	✓	✓	✓	✓	
Computer Interface Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
External Sync			✓						✓		✓	✓	✓	
Remote Control: Standard=S					✓	✓	✓				✓	✓		✓
Remote Control: Keypad=K					✓	✓	✓			✓			✓	✓
Remote Control: Infrared Wireless=W		✓	✓		✓	✓	✓			✓	✓	✓		✓
Loading: Front=F/Top=T	T	F	F	T	F	F	T	T	F	F	T	F	T	F
Height (in inches)	6	5	6	6	5	7	6	7	5	5	5	5	6	5
Weight (in pounds)	33	28	31	29	28	35	30	44	30	28	22	26	28	28
Width (in inches)	21	17	17	21	17	17	21	22	17	17	17	18	21	17
Power Consumption (in watts)	60	33	120	85	33	45	85	110	75	33	30	33	55	33
Typical Applications:														
Arcade Games	✓						✓		✓		✓		✓	
Development Use	✓		✓					✓						
Education	✓						✓			✓				
Internal Network	✓	✓	✓	✓			✓	✓					✓	
Point-of-Purchase	✓	✓		✓			✓						✓	
Training	✓	✓	✓	✓			✓	✓		✓	✓	✓		
Exhibition	✓	✓	✓					✓						

*Some features are not applicable at clv speed

*All information is from manufacturer's published specifications and trade reports

*Out of production but currently still available

Authoring Systems

The creation of computer control software and computer graphics for Level Three videodiscs is a complex and time consuming problem. There is a strong feeling among courseware developers new to videodisc that this problem could be greatly simplified by the use of a simple, easy to use, high level authoring language. There has been a lot of work done to try to create such a tool. Authoring languages have been created for use with popular computers such as the Apple and IBM-PC as well as the integrated systems such as those from DEC, Sony and NCR. However, only two of the producers interviewed for this paper, Digital and the Army, were regularly using authoring languages.

The primary objection to authoring languages is their lack of flexibility. Such languages are developed to support a given set of videodisc/computer operations and instructional strategies. In general the easier the language is to use, the more prescribed are its available strategies. As long as the strategies necessary to support the instruction are possible within an authoring language, it can be an effective tool. It is this basic lack of flexibility, however, that has caused many software developers to avoid them.

Another major disadvantage of authoring languages is transportability. That is, the software created for one specific videodisc/computer combination cannot be easily modified for other combinations. This forces the developer to create system specific software which inhibits potential distribution.

The problems of instructional strategies and transportability not-withstanding, authoring systems can be very useful and indeed if one

cannot afford an experienced computer programmer, they may be vital. No attempt will be made here to review all of the available authoring systems as they are subject to rapid change but following are several important considerations in choosing an authoring system:

1. What instructional strategies will it support?
2. What players/computers will the final courseware run?
3. Is there adequate text and graphics support?
4. What input peripherals will it support?
5. How much computer memory does the software require?
6. Are there appropriate management components such as record keeping or recording user paths?
7. What are the initial costs and/or ongoing license fees?

An excellent report and review of authoring systems has recently been published by Doctors Locatis and Carr of the National Library of Medicine/National Institutes of Health. The report titled "Systems for Authoring Computer-Based Instruction" is a general review of authoring parameters, considerations for choosing an authoring system and a review of fifteen of the readily available authoring systems.

The Team Approach

Videodisc projects usually incorporate a team consisting of an instructional designer, media producer, writer and computer programmer. Some of the team members may perform more than one function but in some form all of these skills are required. Most of the producers interviewed have a designer as the team leader. Only the Army had all of the skills resident within their own agency. All of the others contracted outside for one or more of the roles/services. There is a definite pattern of a symbiotic relationship between the design and programming phase and the production phase, with design and programming from one agency and production from another.

The communication process between team members is a complex problem, particularly with more than one agency generally involved. Several of the producers interviewed have developed software tools to help with the communication process. Several have developed software programs for the very detailed scripting that is required. These are generally of their own creation and are a combination of database management and word processing. Other software tools being used for project control and management include scheduling and tracking programs and budgeting/cost accounting packages like Visi-schedule, Visi-calc and Multiplan.

Cost of Production

All of the producers interviewed for this report were asked how much it costs them to design and produce a videodisc lesson. The answers varied greatly. The cost of a videodisc is like any other medium dependent on factors like production value, actors, locations, etc. Then there are additional variables like the complexity of the instructional design and computer programming. The highest figure quoted in the interviews was by DEC which spent more than $300,000 for a management training videodisc called "Decision Point: A Living Case Study." At the other extreme, the Army Communicative Technology Office claims to have the cost down to less than $10,000 per side for videodiscs produced internally although they stated that this did not include the cost of production services as such services were paid for from other budgets. IXION, Iowa and Videodiscovery stated that their average costs ranged from $60,000 to $90,000 per videodisc side. Perceptronics and DEC would not state an average cost figure but they did state that the average cost was probably in excess of $100,000 per videodisc side. These kinds of cost figures are high in comparison to all but the highest level linear video production but one of the things that must be considered is that these videodisc producers are mostly producing single lessons on very specialized topics or videodiscs that are visual data banks.

REVIEW OF THE 1984 NEBRASKA VIDEODISC SYMPOSIUM

"The Industry Comes Of Age"

This review of the 1984 Nebraska Videodisc Symposium is included in this report as a reflection of the types of videodisc projects that are being produced. The theme of the 1984 Symposium, "The Industry Comes of Age," was selected to reflect a maturing videodisc industry that has moved from research and development projects to on-line uses of the technology. All of the presenters demonstrated applications that were in use or were developed to prove concepts that have been subsequently adopted.

Undoubtedly the most dramatic demonstration of videodisc technology at the 1984 Nebraska Symposium was the "Emergency Room Critical Care System" from Intelligent Images of San Diego. This system, employing a videodisc and computer with touch screen input, is designed to train medical personnel in emergency room procedures by presentation of a critically ill patient who comes to an emergency room for treatment. Specifically, the videodisc component presents a scenario of a patient with a gun shot wound in the chest. Decisions must be made in the form of inputs to the computer as to the course of treatment for the patient. The patient's response to the chosen treatment is shown by alternate paths on the videodisc. The computer also supplies complex readouts and reports of such things as x-rays and blood tests that are ordered. One very interesting aspect of the computer software is that it gives a report at the end of the costs of all tests and treatment that have been ordered.

The flexibility of videodisc instruction and training was demonstrated in a presentation of the ActionCode system by courseware developers from ICS-Intext. The ActionCode system employes a barcode reader that is used in conjunction with supermarket like barcodes that are printed in manuals that accompany the videodisc lesson. As the user follows along in the lesson in the printed manual, he/she passes the reader across barcodes which program the videodisc portion of the lesson for activities specific to that part of the text. The system, developed by Perceptronics, is designed for the integration of text and interactive videodisc. The system is particularly useful where close integration of the two is desirable, such as maintenance training.

Video games were once seen as a great boon to the videodisc industry, and indeed with such videodisc based arcade games as "Dragon's Lair," there was at one point great excitement and a mini-boom in videodisc player sales. The boom became a bust, however, in a very short span of time. According to the presentation by videodisc game designer, Rick Fisher, this was due to two factors: the videodisc based games ignored the basic economics of a rapidly peaking arcade game industry; and the games with a couple of exceptions were not designed well. Mr. Fisher presented an overview of the whole videodisc arcade game industry as well as presenting examples of most of the videodisc based games that were produced. Videodisc arcade games were introduced at a time when the arcade game industry was in a period of decline after an enormous peak. The games, while generating initial excitement, were much more expensive to produce and to purchase with much higher break even points. At the same time, many of the first games were rushed into production and were poorly designed. These two factors led to videodisc based games being

rejected in a few months time by both the public and arcade operators. In short, the initial failure of videodisc based arcade games was due to bad games, not bad technology.

The enormous capabilities of the videodisc to store and retrieve still images were covered in two presentations, one by Image Premastering Services and the other by MetaMedia Systems. Tom Ramsey of Image Premastering Services, reported on his company's project to store 160,000 photographs, posters and glass negatives on videodisc from the collections of the Library of Congress. Special computerized equipment was designed to handle the delicate and valuable originals and to keep track of so many images. The "Chrysler Laser Atlas System," demonstrated by the producer, Thomas Held of MetaMedia Systems, is a system for storage and retrieval of maps from a videodisc in an automobile. Maps of the entire United States were transferred to videodisc frames in several scales. The idea is to make a complete map set available to the driver with the ability to call up and plot routes anywhere in the country. The ultimate extension of the idea would be to use the in-car map system in conjunction with navigation satellites for continuous display of the car's position.

The unique capabilities presented by the common frame numbers on all videodiscs from the same master was demonstrated in the "Westinghouse Integrated Parts Management System," developed by Digital Video Corporation. The Westinghouse system uses videodisc players at different sites that are locked together through a computer. A customer in need of a particular part calls up images that display the exact replacement part needed. A service representative at the plant or warehouse also sees the same image and can advise the customer if the correct part has been

located. By making a few entries into a terminal with a simple controller, the customer can then order the part and get delivery information.

The University of Iowa's use of videodisc for instruction was discussed by Iowa Doctoral Student, Lynn Johnson. Iowa has produced a number of videodiscs on a range of topics from medical education to a videodisc based system for teaching film editing. They have also been producing archival videodiscs for their own use with thousands of still images. Virtually all of the videodiscs have been produced with internal funds. Iowa has developed their own software tools to help with design, scripting and project management. They have also extensively utilized graduate students for design and computer programming tasks. The degree of videodisc utilization at Iowa and the way that they have managed to marshal internal resources for videodisc production could serve as a model for any large postsecondary institution.

The basic technology of laser optical videodiscs is going to become increasingly important in the storage of digital data as well as video-analog information according to the presentation by Frank Price of the Optical Recording Project-3M. 3M, like several other companies such as Philips, Hitachi and Sony, is gearing up to manufacture optical recording media for mass storage of digital data. Depending on the size of the disc, optical discs can store up to several gigabytes of information. The so-called CD-ROM which is a digital data storage variant of the Compact Audio Disc, will be a common computer peripheral within a very short time providing the storage equivalent of over 100 standard floppy disks.

Reports of the evaluation of three major videodisc projects were presented in a videodisc research panel session. Reports were presented on courseware from DEC, The Florida Department of Human Resources' AFDC Caseworker Training Project and the University of Nebraska's Annenberg/CPB Project funded "Alternative Science Laboratories." All three projects had extensive and carefully designed summative evaluation components. The methodology and specific results are too complex and detailed to explicate in this report. However, there were certain common findings from the evaluation of all three projects. In all three:

-- Students spent less time learning with the videodisc based systems than they did with the traditional training systems.
-- There was no significant difference in learning with the videodisc systems. That is, students learned just as well from videodisc as they did from traditional systems.
-- Students generally liked the videodisc based training as well or better than traditional training environments.
-- In the case of the DEC and Florida videodisc based training there were substantial cost savings with the videodisc based systems.

PUBLIC TELEVISION STATIONS

PTV Station Involvement

Several PTV stations or their parent agencies have been actively involved in the design and production of interactive videodiscs. Nebraska has probably been the most involved having created a separate videodisc design and production group which dates back to 1977 with a series of research and development grants from Corporation for Public Broadcasting (CPB). The Nebraska Videodisc Design/Production Group is an entirely self-supporting agency within the Nebraska Educational Television (ETV) Network. The Nebraska Group has produced over 100 videodiscs under grants and contracts from both public and private agencies. All of the videodiscs have been in the area of education and training. In addition to the work at Nebraska, San Diego, Boston, Washington and the Maryland Network have produced videodiscs. Boston and New York have been exploring the conversion of existing broadcast series to videodisc. Maryland has tested the use of videodisc as a broadcast medium. San Diego has produced training videodiscs for external agencies. University owned stations at Florida State University and Pennsylvania State University have produced videodiscs for their parent agencies and the stations in Duluth and St. Paul Minnesota are working with the University of Minnesota-Duluth on an IVIS system project.

Future Prospects

The primary market for videodisc production at this time is for dedicated training commissioned by corporate and institutional entities. This market is rapidly expanding and represents a significant opportunity

for PTV station revenue in the immediate future. The key to tapping this market, however, is the station's ability to accept contracts from corporate and military entities. The station must be financially, legally and physically structured to accept such commissions. For many stations such business is substantially different from their current client base. Many stations will have to create separate for-profit agencies outside their existing structure. For some stations, particularly those tied closely to school systems or state departments of education, this may be politically impossible.

The educational market has been a traditional market for stations and as this market turns to interactive videodisc there will be substantial opportunities in this area. This has been the slowest market to develop. Looking ahead to the next five years, however, the educational market should show a substantial increase in the use of interactive videodisc. The greatest activity will come first at the postsecondary level. There is great interest among college and university faculty in interactive videodisc and there are literally dozens of projects in the early development stages.

The primary and secondary school markets for interactive videodisc will be very slow to develop although in pure dollar terms, this part of the education market has the greatest future potential. There has been substantial interest from primary and secondary level educators and electronic media publishers but they feel that they there is simply not a sufficient user base and that they do not have the money to develop videodisc software. The user base argument ("no chickens no eggs; no eggs no chickens") is a perfect circular argument. Without aggressive attempts to break the cycle it will be self-fulfilling. Key people in

the public education sector must be convinced of the power of this new technological tool and convinced enough to make the crucial first investments. There are some signs that this is starting to happen. Many conferences of educators are including videodisc demonstrations and awareness level workshops. There is also some movement at the federal level with the National Science Foundation and The US Department of Education funding small projects for interactive videodiscs for primary and secondary use. Most of the current projects are for teacher training but this is a good first step.

The money for development of interactive videodiscs for the educational market will ultimately have to come form the same sources that have financed instructional television programming in the past. At the state and local level it will have to come from state agencies, school districts and colleges and universities. There will have to be national consortia to share the costs, either on an ad hoc basis to produce a specific program or series or through centralized agencies. Some money is and will be available from federal agencies, although not on a scale that we have seen in the past. Undoubtedly, this diversion of resources into new technologies will delete the available pool of funds that has been available for broadcast programming.

The costs of videodisc production have been seen as prohibitive and indeed the cost of development of Level Three courseware is higher than all but the most expensive linear programs that have been produced. This high cost has little to do with the videodisc per se, but rather with the costs of development of the much greater quantity of lesson material in a typical Level Three videodisc. The costs of producing Level One and Two videodiscs need not be much different from those of linear programming.

These two levels of interactivity can be used very effectively in individualized and teacher led instruction. The hardware cost and technical complexity is also greatly reduced as no external computer is required. One key factor in developing the educational market for videodiscs may be to refocus attention from considering only Level Three, computer controlled videodisc software, to effectively utilizing Levels One and Two.

Management and Marketing

Perhaps the greatest issue for PTV stations wishing to sell videodisc design and production services is that much of the current market is beyond the scope of their existing clientele. As stated previously, most of the money for interactive videodiscs is presently coming from commercial entities. It is not too difficult to justify industrial training as simply an extension of existing educational activities, but what about clients who want to purchase software for point-of-purchase or even entertainment applications? In many cases it will require structural and legal changes in the way a station operates. Commercial clients demand a much different kind of handling than school systems or state departments of education. For one thing, they generally want product much faster and will sometimes impose penalties for late delivery. Further, their demands during design and production may not be as negotiable as the stations' traditional clients. They may require very detailed bids and the right to audit fiscal and time accounting. In general, if the project goes over budget they will not simply increase the size of the contract without prior negotiation. It is also tempting,

particularly at first, to take on small, enthusiastic clients who may never be able to pay their bills. New technologies seem to attract entrepreneurs who have no resources behind them beyond a "good idea."

Products and Services

The development of interactive videodisc software is a multi-stage process involving design, production, premastering (the post production assembly of all the audio/visual elements onto videotape for release to a mastering facility) and, with Level Three videodiscs, computer programming. The station must decide which of these parts of the process it is able to engage in. Commercial clients will generally want to contract for all stages of the process with the exception of some clients who will want to purchase premastering services only. In order to offer parts of the process as a service, the station may have to form alliances with other entities that can do parts of the process such as design or premastering.

Videodisc software is another potential product. The market at present is rather limited, however, and some initial market research must be done to determine if the market is great enough to make distribution worthwhile. Another critical factor is interchangeability. All videodiscs will not play on all players, at least in the manner in which they are designed to be used. Level Three software is even more difficult to distribute as it requires specific computers with specific peripherals including the videodisc player. One must either focus on a specific system or design the videodisc and computer software to run on a number of combinations of hardware.

Staffing and Hardware

Interactive videodiscs require expertise not necessarily available at every station. Design and production of high level interactive videodiscs requires a knowledge of interactive learning theory, computer programming and design of graphics and motion materials that are different from linear models. Existing staff may have to be retrained and additional staff or contract personnel acquired. In general, however, experienced instructional producers and designers can move fairly easily into producing interactive videodiscs.

Hardware for production is not a great problem for well equipped stations. Normal video and film production equipment can generally be used with some additional attention to control of video levels and contrast ratios. Post-production/premastering is a more critical problem, but, in general, most computer controlled, broadcast quality editing systems can be used if great care is exercised. One important piece of hardware is a high level graphics/character generator, but most of the better such pieces of hardware acquired in the last 3-4 years will do.

Getting into the business

Some of the business of producing interactive videodiscs will come as a natural evolution of the work of existing clients, particularly in education. To capture some of the market for industrial and institutional training (currently estimated at about half a billion

dollars and projected to expand into a multi-billion dollar market in the 1990's) stations must be prepared to refocus and change their operating procedures.

The Videodisc Consortium

The Interactive Videodisc Consortium should be an important vehicle for PTV stations' and public telecommunications centers' entry into videodisc. The seven founding members are, WGBH/Boston; WNET/New York, WCET/Cincinnati; KBPS/San Diego; WHRO/Norfolk; Nebraska ETV; and the Maryland Center's Division Of Interactive Technologies. All of the founding members have a substantial interest in producing for videodisc and some of the members have considerable experience and expertise in videodisc design and production. Formed with the encouragement of Corporation for Public Broadcasting (CPB), the consortium's major objective is to provide a vehicle for information exchange, sharing of expertise and integrated research efforts within the public television community. For example, the consortium has a CPB grant to explore issues of videodisc hardware specifications and standardization, a critical issue in the development of a market for educational videodiscs.

APPENDIX

In-depth interviews were conducted with seven videodisc developers for this paper. Following are descriptions of the developers and a review of the major achievements and concerns of each.

Perceptronics

Woodland Hills, California

Perceptronics is both a software and hardware design agency. They have designed several custom delivery systems for specific applications. Perceptronics tends to view delivery systems as a function of what is to be accomplished and not simply as generic devices which will run a great variety of courseware. They have produced several types of videodisc based simulators, from tank gunnery simulators with controls similar to the actual device to an exercise bike that provides visuals of varying trails on a large front projection screen in front of the exercyclist. A specialty of Perceptronics is large scale terrain mapping using videodisc. Perceptronics also developed the ActionCode videodisc based training system. ActionCode employs a stylus barcode reader that is used in conjunction with printed barcodes in special training manuals. As the user goes through the manual he/she programs computer/videodisc materials related to that section of the manual by passing the barcode reader over barcodes printed in the manual. The ActionCode system is generally recognized as an excellent way of integrating videodisc with instruction manuals.

One of the areas of research by Perceptronics is the types of input systems used in interactive videodisc systems. They have done human factors analysis looking at such things as physical fatigue of learners trying to continually respond to touch screen devices. Their general conclusion is that there is no single best input device but rather one must select from a number of devices such as touch screens, keyboards, etc. depending on factors of content, instructional strategies and environment.

A particularly intriguing interest of Perceptronics is in finding ways to better utilize the material on a videodisc by improved instructional design strategies. Their point is that much of a videodisc is typically filled with material that is used only for remediation. This material then is never used by a significant number of learners who make the correct responses and therefore do not need the remediation. Dual use of the visual material with different audio tracks or relegating remedial materials to stills or computer text and graphics would maximize the use of available videodisc space. Perceptronics also feels that new design strategies must be developed that do not rely so much on traditional multi-branched pathing which encourages the proliferation of little used branches.

Army Communicative Technology Office

Fort Eustis, Virginia

The Army has an enormous need for training. The American military operates some of the most sophisticated devices in our society with a work force that most often has little knowledge of such systems and that is constantly turning over as enlistments are up. The Army has been very interested in the videodisc as a training tool and has devoted a lot of resources to production and implementation of videodisc based training. Extensive facilities and staff at the Army Communicative Technology Office at Ft. Eustis have for some time been dedicated to exploring specific applications for videodisc. Videodisc production and research has also been conducted at other Army training media production centers and a number of projects have been contracted out to external commercial and educational agencies.

The Army has used interactive videodisc for a wide variety of subject matter. One interactive videodisc for example trains soldiers how to adjust their rifle sights while another trains officers in disciplinary skills. An important emphasis is on time compression; videodisc simulation that allows trainees to run through a complete process in less time than the real activity would require. Another very important area of emphasis is simulations that replace very expensive equipment or that allow for simulations of environments that are too dangerous.

The decision to use videodisc for a particular training need is made on a case by case basis. There is no general mandate to make videodisc serve as an all encompassing instructional device. Indeed, videodisc has

been rejected in a number of cases where the need for interactive visual instruction was not apparent. The emphasis in short, is to meet a particular training need with the most efficient and cost effective medium available.

Two areas of primary concern and research for the Army have been standardization of hardware and design and production procedures. In the area of hardware they have been working with manufacturers on an integrated videodisc and computer system. The system would be an integrated package, "ruggedized" and easily transported for field use. Standardization of design and production procedures has centered on the development of computer software tools for project management, scripting, storyboarding and flowcharting. The Army feels it needs such tools to speed the videodisc production process, lower design and production costs and provide standardized project communication tools for work with external contractors as well as the many producing agencies within the Army. The system that they have been working on is called the Production Management System (PMS). Essentially, PMS is a full cycle software package that starts with something like a flowcharting process that leads in stages to storyboards and scripts, all without the usual huge paper trail. Many elements can be easily tracked from branching structures down to a database of necessary props.

Authoring systems have been of great interest to the Army as part of the overall development process. Various computer languages have been used and they have examined several available authoring packages. They have developed an authoring system as part of PMS but at present it is specific to videodisc. They would very much like to have a system that would meet straight computer assisted instruction needs as well and are working toward developing such a universal authoring package.

The Army did formal evaluations on several of their early pilot projects. The evaluations indicated a high degree of acceptance on the part of instructional staff and trainees of videodisc systems and other than pointing out areas for future improvement, it is generally felt that the evaluation studies did prove videodisc to be an effective instructional tool.

IXION

Seattle, Washington

IXION is typical of a number of small videodisc production companies, an organization started by one of the early producers. IXION was founded by David Hon who gained a considerable reputation for his work in creating the videodisc based CPR training course. Hon is very much the driving force behind IXION but has brought several talented people into his organization.

IXION operates on a pattern of minimal overhead with a core staff of less than a dozen people. When additional people are needed they are hired on a contractual basis, project to project. IXION also does not own its own video production facilities, not wanting to make the substantial capitol investment that would be required. IXION, like all but a handful of videodisc design and production houses, sells experience and expertise and buys specific skills and production facilities from other suppliers.

Many of the clients of IXION have decided on interactive videodisc based on some degree of needs assessment. Much of the initial work with clients, however, is often in helping them further refine their needs and in educating them about the capabilities of the delivery systems. Hon feels that one of the critical problems in setting measurable criteria for a project is that it requires a commitment and exposure on the part of the decision makers. In other words, if the project does not meet the goals that have been established, management can be seen as having failed.

Hon feels that one of the areas of greatest potential for videodisc is mechanical simulation. His goal is to achieve very sophisticated simulations by using input devices that look and act like real instruments. The material on the videodisc must therefore reflect an accurate visual and auditory representation of what happens if the user pushes a button or opens a valve, etc.

IXION is not currently using computer software tools for project management other than a scripting program developed within the company. Hon feels that at their present size there is a high level of interaction among personnel and that such complex tools are unnecessary at this time.

IXION is not using authoring languages. Programming is being done in various computer languages determined by the needs of the project and the operating hardware. Hon feels that at this time the available authoring languages do not offer sufficient flexibility to cover the range of applications IXION is working on.

EPCOT - Walt Disney World

Orlando, Florida

The EPCOT center in Orlando was virtually the first place to use videodiscs in a public access environment. It is still certainly the largest with 300 videodisc players online. There are two types of uses for videodisc at EPCOT, information access and exhibits within theme displays. All of the systems employ touch screen inputs and are operated by central computers.

The information access usage of videodisc is available from a number of kiosks throughout the park. The kiosks, called the World Key Information Center, each have multi-touch screen terminals controlling centrally placed videodisc players. Park visitors may call up information about specific attractions in the park in the form of videodisc segments.

As exhibits, the videodisc systems are used several ways. One particularly attractive videodisc demonstrates the use of computer aided design by allowing visitors to build their own roller coaster. The user chooses from sections of straight or curved track by touching a section displayed on the screen. After the sections are assembled the user sees a computer generated animation of his/her roller coaster. Another very interesting exhibit provides information on energy problems and allows visitors to test their knowledge of energy resources.

The videodisc applications at EPCOT have been very popular attractions. They have also doubtlessly spawned much of the interest in point-of-purchase and point-of-information applications that we are

seeing presently. One of the most dramatic features of the videodiscs at EPCOT is their transparency; most users have no idea they are seeing videodiscs.

The University of Iowa

Iowa City, Iowa

The videodisc effort at the University of Iowa is one of the oldest of any academic institution. Iowa's first videodisc materials were produced in 1978 for the Thompson transmissive videodisc, which was withdrawn from the market in 1981. The transmissive videodisc was of great interest for archival applications as both sides of the videodisc could be read without turning the videodisc over. All subsequent projects at Iowa have been for the optical reflective videodisc but they have continued to be interested in archival applications particularly for storage of art images and photographs. In addition to archival applications, they have produced videodiscs in medical education and teacher training. One of the most interesting projects is a videodisc system that allows students to simulate the audio and video editing process. The videodisc projects at the University of Iowa have all been produced out of the Weeg Computing Center and have all been Level Three, computer controlled. Dr. Joan Sustik Huntley who has spearheaded virtually all of the videodiscs at Iowa said that they tend to view the videodisc as a kind of ultimate computer peripheral providing a rich audio-visual dimension to computer assisted instruction.

Iowa is something of a model for the production of interactive videodiscs for internal use by a postsecondary institution. Through an internal grants program, on-campus production of the visual media, and by judicious use of skilled graduate students, they have been able to encourage their faculty to use videodisc to meet on-campus instructional needs. The computing center has always had a service orientation to

faculty, and the videodisc has simply become an extension of that service. A good bit of promotion has also been done by Dr. Huntley and her colleagues, raising awareness on the campus to the potential of videodisc.

A critical factor in Iowa's success has been the development of a working relationship with the campus video production center. The computing center provides design, scripting and computer software authoring while the video production center does the actual film and videotape production and premastering. This process has been aided by the development of scripting and production software tools that provide detailed specifications of all audio-visual elements. The video center has also purchased specialized production tools that speed the production of videodisc materials, thus lowering the cost.

In determining the suitability of videodisc for suggested applications, Iowa looks at three primary criteria. First, they examine the need to see if it involves a large still or high fidelity realistic motion database. Second, there must be a need for a high degree of sophisticated control of the videodisc player in order to provide the necessary level of interaction for instructors or students. Finally, there must be a need for rapid access to visual and auditory material or a complex branching structure.

In designing videodisc materials, Iowa attempts to maximize user control and flexibility. Building on experience from earlier programs, some of their latest materials allow for a lot of user determination of sequencing and the ability for the user to skip, backup and repeat. They are also experimenting with a screen printer that will allow users to

print a hardcopy of images called up on the videodisc. The screen printer will be used with a major still image archive videodisc and will allow instructors or students to study the material away from the videodisc.

Digital Equipment Corporation

Bedford, Massachusetts

Digital Equipment Corporation (DEC) is the manufacturer of a powerful integrated videodisc system called IVIS. The IVIS system has a powerful computer with excellent color graphics capability, a touch screen and/or keyboard input and a videodisc player. They have developed a powerful authoring system called Producer to write control software and create graphics. The IVIS system is about $14,000.

DEC views the videodisc as another extension of computer based training and information systems. They are therefore marketing IVIS as an extension of their other computer hardware products. In addition to marketing a hardware system, DEC is creating software for internal and external use. They also market IVIS based videodisc software produced by others. Videodisc software developed for IVIS is generally very powerful, utilizing the computer graphics power of the system as well as the video from disc. Generally very sophisticated instructional strategies are used that take advantage of the large scale processing power of the system.

DEC feels that given an appropriate design, interactive videodisc can be used for any content area. However, they feel that the most appropriate use of interactive videodisc is in areas where there is a high density of information and where the content is by nature interactive enough to justify running the course on a computer system.

A critical barrier to the use of videodisc, according to DEC, is the cost of the delivery systems. They feel that the market is limited to companies or institutions with the ability to purchase relatively

expensive systems. They look for the cost for highly sophisticated videodisc/computer systems to come down, however, and for the cost of courseware development to drop also. They did not offer a timetable on when this would happen.

Videodiscovery

Seattle, Washington

Videodiscovery is a company that has grown up around a single type of videodisc application, generic database videodiscs. The idea is to provide a generic visual resource base that may be used in many kinds of applications. The first videodisc produced by Videodiscovery is in biology. The videodisc has thousands of single frame images of such things as birds, sea creatures, cell division and insects. There is also some motion on the videodisc, as in the segments showing cell division in time-lapse photography. The videodisc comes with a comprehensive index indicating where all of the images may be found by videodisc frame number.

Videodiscovery was founded by Dr. D. Joseph Clark, formerly of the University of Washington in Seattle. Dr. Clark has, of necessity, become something of a salesperson for videodisc technology. He has developed a market by directly demonstrating the materials to potential users. Dr. Clark feels strongly the key to the schools' market for videodisc is to enter at the lowest level of cost and the highest level of need. That is, providing videodiscs that are relatively inexpensive to acquire and that can be used on lower priced videodisc players whose subject matter is in some critical area such as science. He feels that once instructors see the power of the technology and see it as a medium that is both very flexible and very easy to control, they will want more and more.

Videodiscovery has had to confront one of the most frequently discussed problems in producing videodiscs that are large databases of existing materials, the problem of copyright. The transfer of images to

a new medium, particularly one that by nature is designed for multiple copy distribution, requires release from the copyright holder. This can be a tedious and expensive proposition, particularly when an existing collection of slides, photographs and other still images has been compiled from a number of sources. One of the arrangements that Videodiscovery has been able to make is to arrange for a royalty payment to the copyright holders for each videodisc that is sold.

Dr. Clark believes that two new videodisc capabilities will greatly extend the power of still frame databases; still frame audio (SFA) and combined analog and digital videodiscs. SFA makes it possible to have audio with the stills, an obvious and often requested feature. At present, this capability adds about $2000 to the delivery system and greatly increases the cost of videodisc production. Both the hardware and software costs for SFA are expected to come down. The second capability, combined analog and digital videodiscs, could be the basis for very powerful instructional systems. In such a videodisc the disc contains both the still frame or motion database and what can be very powerful programming for an external computer. The computer programming can offer very sophisticated methods of using the images either for preprogrammed lessons or for teachers or even students to create their own lesson materials.

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